



THE HOUSE WEDNESDAY GROUP

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BACKGROUNDER

ON

RECOMBINANT DNA RESEARCH

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Executive Committee

July 20, 1977

In 1973, two Stanford scientists brought into reality a long-held dream of science fiction: the manipulation of genes to create new forms of life. The breakthrough generated instant excitement -- and worry -- in the scientific community, and recently has become the focus of a complex and emotion-ridden public controversy. At stake are a number of important issues, including freedom of scientific inquiry, the public safety, and the ethics of "tampering" with life.

The hereditary traits of every living organism are determined by a substance, contained within each cell, known as DNA (deoxyribonucleic acid), the component of genes. The Stanford researchers discovered that, using chemicals and techniques developed over the previous decade, they could isolate DNA from two different organisms, cleave it into fragments, and splice it back together in new combinations. When the new, "recombinant" DNA was reintroduced into a living cell, it operated much as normal, but conferred new and different traits upon its host. They dubbed the new organism thus created a "chimera," after a mythical creature that was part lion, part goat, and part serpent.

The creation in the laboratory of strains of life which do not occur in nature, many fear, opens up a Pandora's box of dangerous and unforeseeable consequences. New and unpredictable living organisms could be produced by the recombinant process, leading to epidemic disease or a serious disruption of the ecosystem. Alternatively, known disease-causing organisms could be given an immunity to antibiotics, neutralizing man's ability to keep them under control. On the other hand, scientists generally agree, recombinant DNA offers many exciting possibilities for learning about hereditary mechanisms, expanding our technology, and treating disease.

While few advocate a total ban on recombinant DNA research, heavy debate has been waged, since the discovery of the process, over the appropriate precautions and regulations which should be imposed. Up until now, only recipients of federal grant money have been subjected to guidelines outlining protective measures to minimize the hazards of the research, and those steps are voluntary. Currently, though some members of the academic world are still in opposition, legislation is being prepared in both the House and the Senate to develop a comprehensive national strategy governing the conduct of all recombinant DNA work in the country.

Recombinant DNA

DNA, the chemical component of genes and chromosomes, plays a dual role in living cells. As the carrier of the genetic "code," it passes hereditary traits on from generation to generation. Each time a cell reproduces, its DNA splits apart and forms two new copies of itself --

one for the parent cell and one for the new cell. The second role of DNA is to direct, through its code, the physical and chemical attributes of the cell.

For several years prior to the first successful genetic engineering experiments at Stanford, scientists had been able to manipulate DNA molecules, cutting them and joining them together again with the aid of a new-found group of enzymes, isolated from bacteria, which served as chemical "scalpels." While they had succeeded in putting together new gene combinations in this fashion, however, they had yet to make them actually function in a living cell. As a result of the splicing process, the DNA strands seemed to become inactive.

The two Stanford scientists, Stanley Cohen and Annie C. Y. Chang, discovered, for the first time, an ingenious method of inducing a "spliced" DNA molecule to actually function within a living cell, both copying itself as the cell reproduced, and imposing its hybrid instructions on present and future generations of the cell. They utilized a form of bacteria called E. Coli (escherischia coli), well-known to scientists because it colonizes the human intestine. E. Coli contained small, donut-shaped loops of DNA, separate from the main genetic unit, called "plasmids," which occasionally passed between two bacterial cells in a form of sexual reproduction. Cohen and Chang found that by splicing foreign DNA fragments onto plasmids, and allowing the plasmids to act as carriers, they could introduce functional recombinant DNA into E. Coli.

In their earliest experiments, Cohen and Chang spliced together DNA from E. Coli and other types of bacteria. Then, once they had established the technique, they found that they could splice genes from practically any living plant or animal into E. Coli, which they demonstrated by propagating toad genes in the bacterial cell. For the first time in a laboratory, they succeeded in breaking the so-called "species-barrier," which ordinarily prevents genetic crosses between unrelated organisms.

Since the early, rudimentary stages of recombinant DNA research, scientists have quickly begun to develop more broad-ranging and sophisticated forms of genetic engineering. New chemicals and techniques have been discovered which permit different kinds of DNA splices to be made. Viruses have been added to plasmids as carriers of recombinant genes, and many new kinds of intracellular genetic transfers have been made. At this point, the possibilities for rearranging genetic material seem almost without bound.

Benefits of Recombinant DNA Research

Recombinant DNA research is still in its early phases, and a great deal remains to be learned about its capabilities. Nevertheless,